(a) The transmitter output port shall be connected to either a spectrum analyzer via an attenuator, or an artificial load with some means of monitoring the emissions with a spectrum analyzer. The spectrum analyzer shall have a variable persistence display or digital storage display and its controls shall be adjusted as follows:-

Bit Rate (Mbit/s)	2	2x2	8	2x8	34	140 155
Channel Spacing (MHz)	3.5	3.5	7	14	28	112
IF Bandwidth (kHz)	30	30	30	30	100	300
Total Sweep Width (MHz)	As Appropriate					
Video Bandwidth (kHz)	0.1	0.1	0.1	0.1	0.1	1
Recommended Scan Time (s)	20	25	25	25	20	5

(b) The transmitter line input shall be modulated by a digital signal having the appropriate characteristics given in Table 2.1. The display shall be recorded, relative to the level of the unmodulated carrier as measured in clause 2.2.

(c) The measurement shall be made under normal test conditions (Part 1 Section 2.3) and repeated under extreme test conditions (Part 1 Clauses 2.4.1 and 2.4.2 applied simultaneously).

Note: Since the spectrum masks of Figure 2.3 incorporate an allowance for frequency stability, any deviation (measured in 2.1) from the nominal centre frequency (declared in Part 1, clause 1.4(a)(i)) must be taken into account when comparing the radiated spectrum with the limits of Figure 2.3.

(d) The transmitter line input shall be modulated by a digital signal having the characteristics indicated in Clause 1.2. The level of any residual carrier, shall be recorded, relative to the level of the unmodulated carrier as measured in clause 2.2.

2.4.2 Limits

(a) The 0 dB spectrum reference level (SRL) shown in the spectrum masks given in Figs 2.3A to 2.3F shall be set to the level calculated by the formula in sub-clause 2.4.2(c).

(b) The recorded spectra of 2.4.1(b) shall be compared with the appropriate figure in Figure 2.3. Spectrum peaks due to the modulation process shall not exceed +3 dB relative to the SRL, between 0 MHz and the first break-point of the mask (shown as a dotted line).

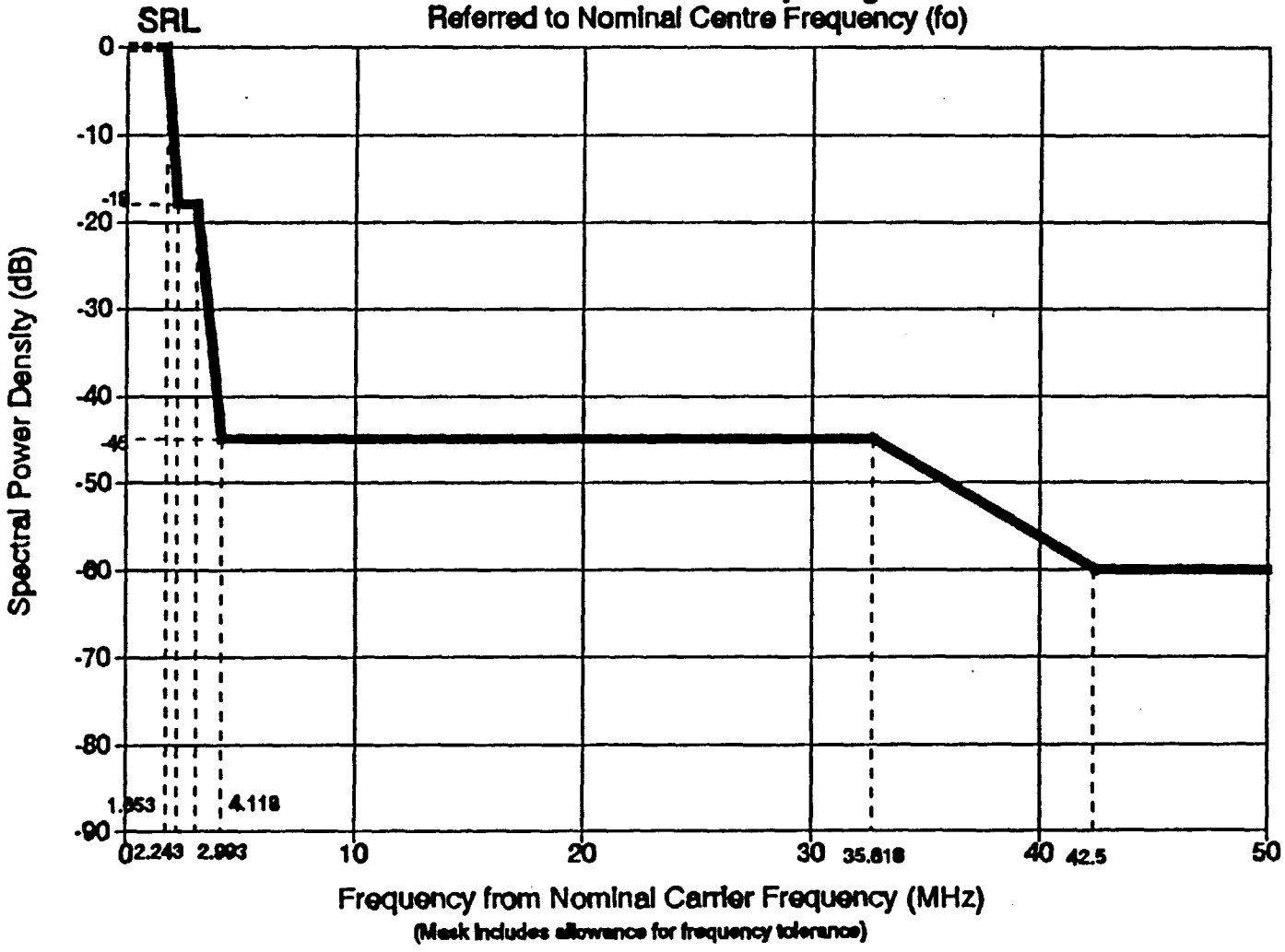
(c) The SRL shall be calculated using the following formula:

$$0dB\,SRL = Carrier\,Power - 10\log_{10}\left(\frac{Symbol\,Rate\,(Bauds)}{Analyser\,IF\,Bandwidth\,(Hz)}\right)$$

(d) The residual carrier level (2.4.1(d)) shall not exceed -15 dB relative to the value of the unmodulated carrier.

Fig 2.3A Limits of Spectral Power Density for Minimum Bit Rate of 2 Mbit/s

Fig 2.A Limits of Spectral Power Density for Minimum Systems Rate of 2 Mbit/s
3.5 MHz Channel Spacing
Referred to Nominal Centre Frequency (fo)



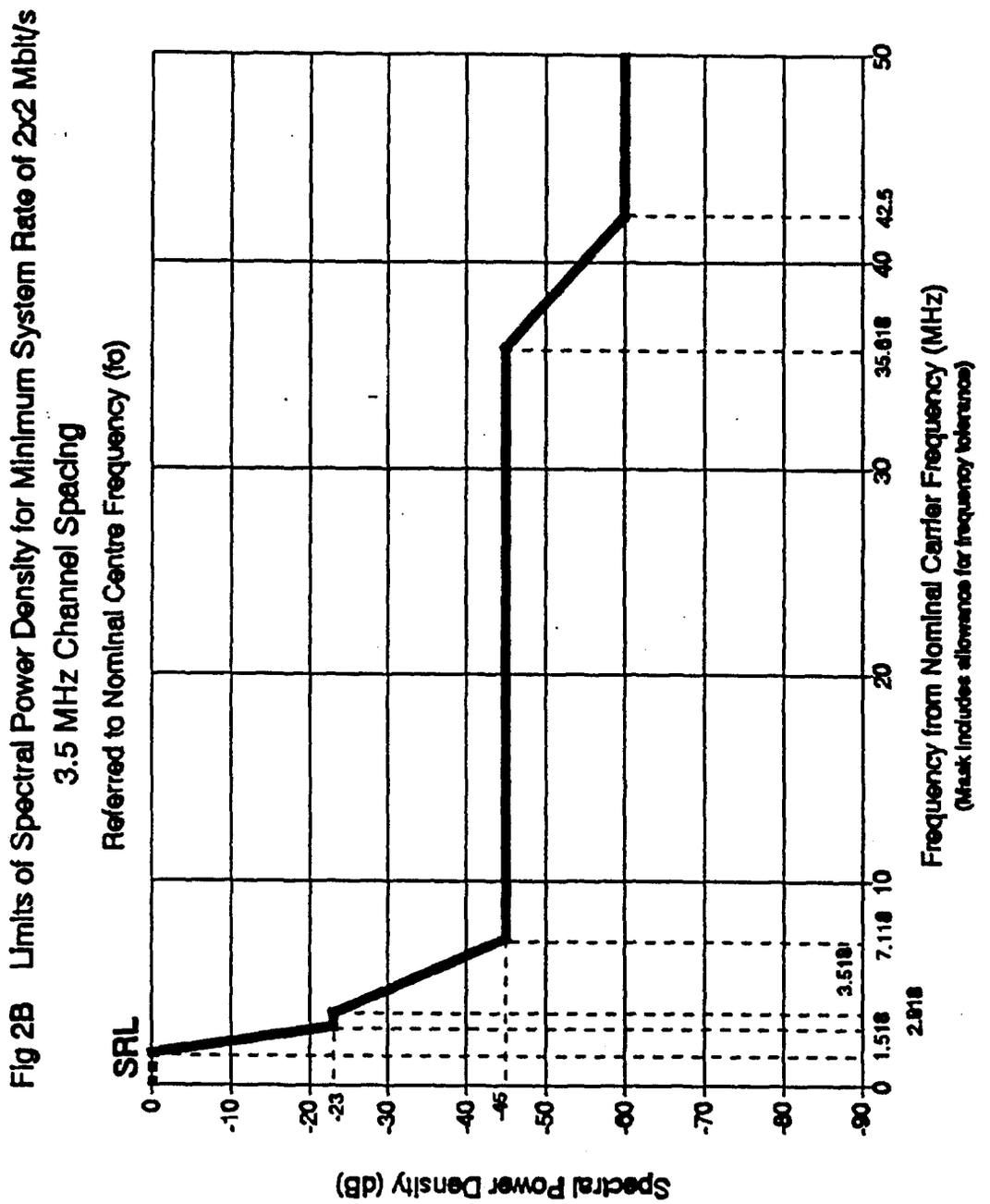


Fig 2.3B Limits of Spectral Power Density for Minimum Bit Rate of 2 x 2 Mbit/s

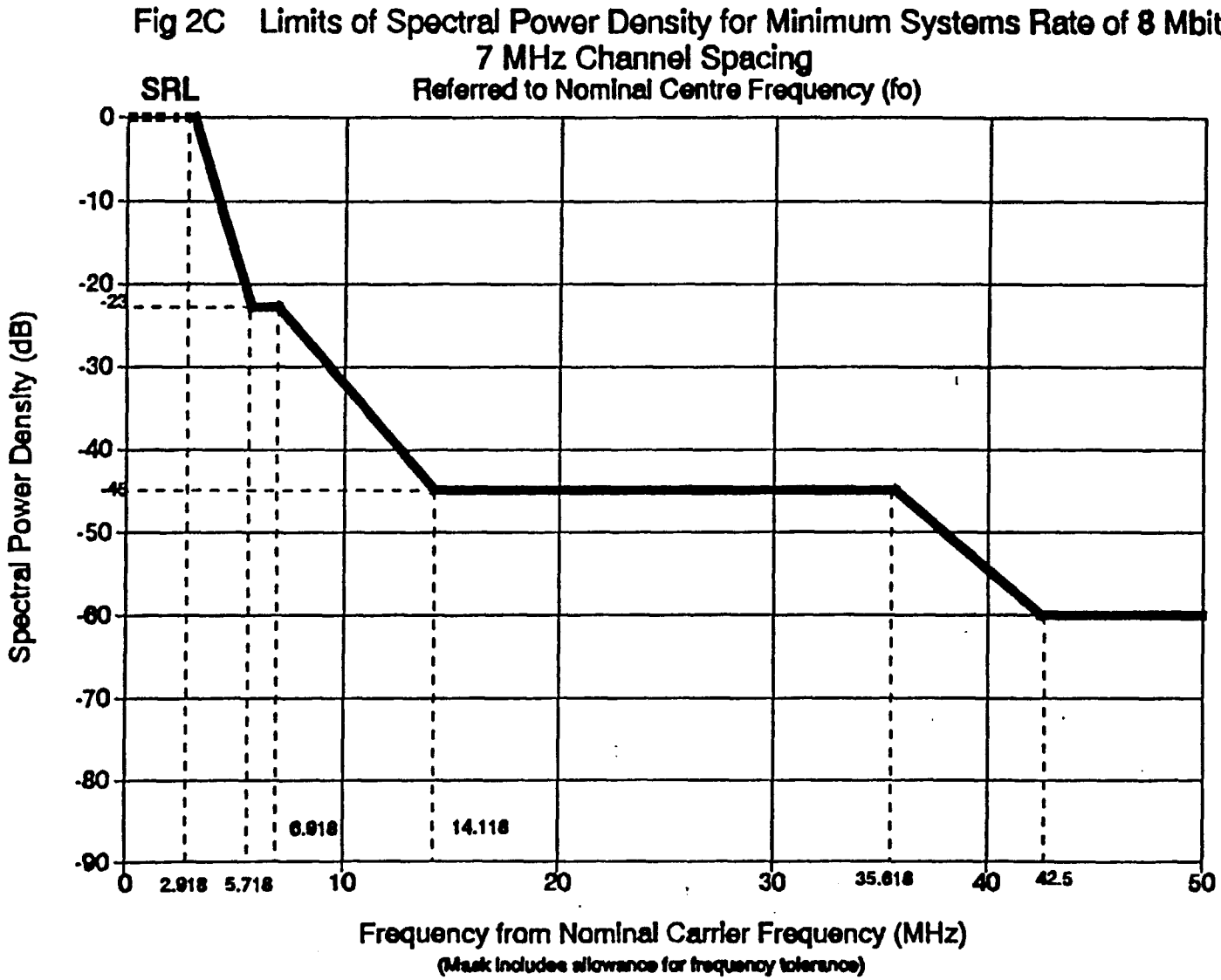


Fig 2.3C Limits of Spectral Power Density for Minimum Bit Rate of 8 Mbit/s

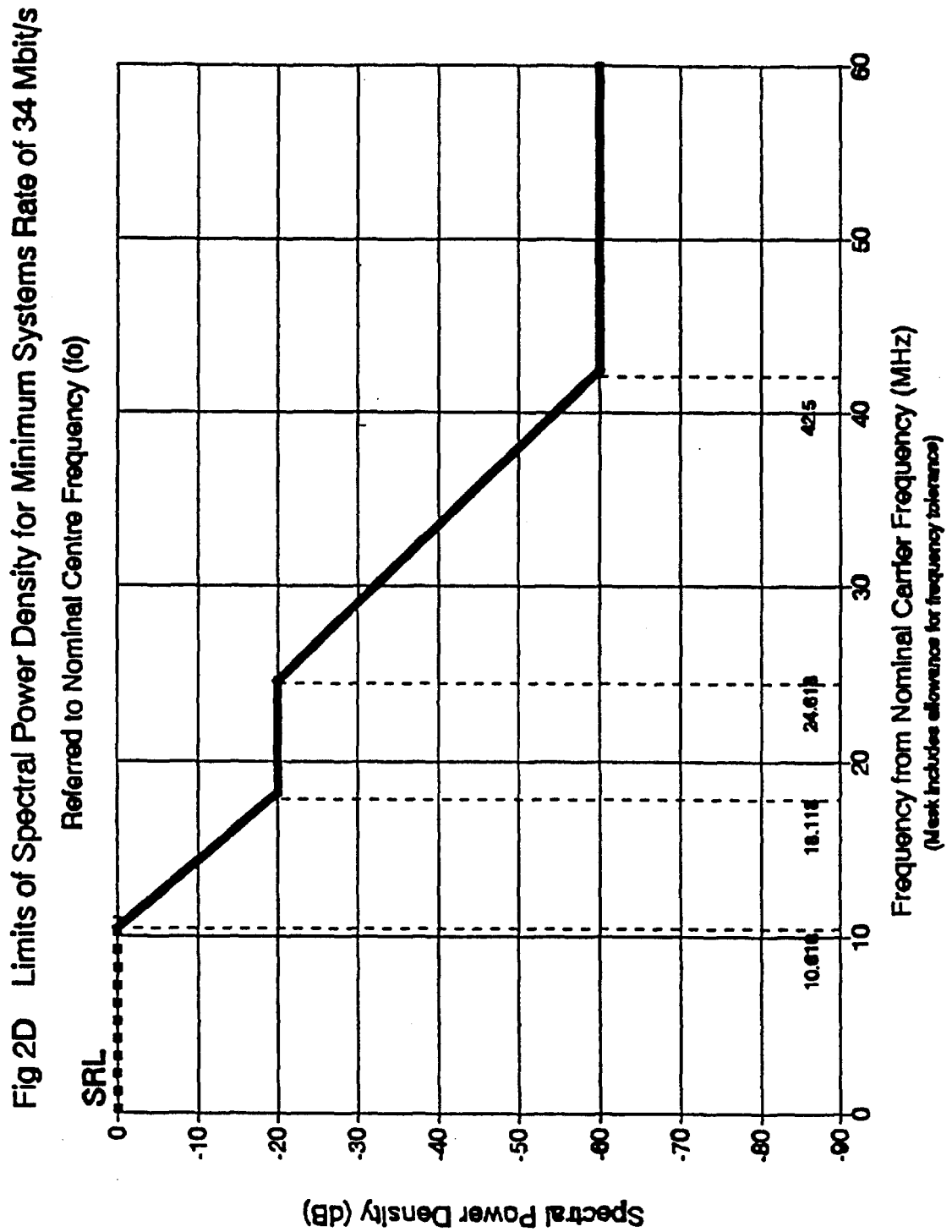


Fig 2.3E Limits of Spectral Power Density for Minimum Bit Rate of 34 Mbit/s

Fig 2E Limits of Spectral Power Density for Minimum Systems Rate of 140/155 Mbit/s

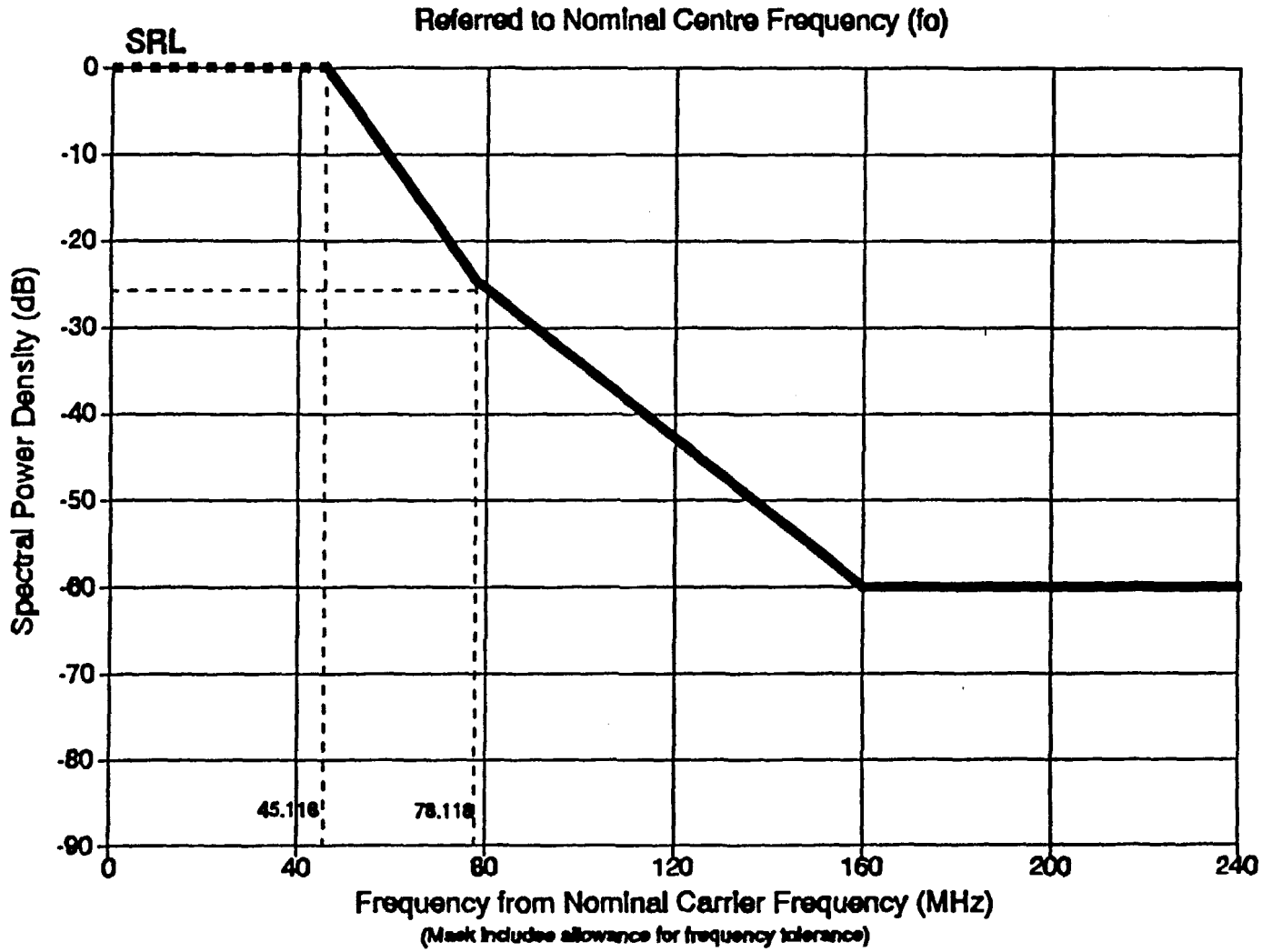


Fig 2.3F Limits of Spectral Power Density for Minimum Bit Rates of 140/155 Mbit/s

3 Receiver

3.1 Input level range

The input level range for a BER $<10^{-6}$ shall extend from the upper limit of -50 dBW to the lower threshold for BER = 10^{-6}, measured at point C.

3.2 BER performance

The reference sensitivity of the receiver, for a BER of 10^{-6} is given in Table 2.2.

3.3 Interference sensitivity

3.3.1 Definition

In the context of this specification the interference sensitivity of the receiver is an indication of its ability to receive (with a given minimum quality) a wanted modulated signal at the receiver reference sensitivity input level (threshold, or faded level) in the presence of an unwanted modulated signal of a given level and specified frequency.

3.3.2 Method of Measurement

3.3.2.1 Co-channel interference

(a) A bit error monitor capable of detecting errors in the sequence described in 1.2 at the bit rates of Table 2.2 shall be connected to the receiver output.

(b) A standard test signal (Section 1.2) shall be applied to the input port of the receiver via one path of a combining unit. The level of the signal at the receiver input port shall be the reference sensitivity input level given in Table 2.2. The frequency of the standard test signal shall be that of the wanted receive frequency.

(c) An interfering test signal having the same characteristics as described in Section 1.2 shall be applied via the second path of the combining unit. The frequency of the interfering signal shall be at the nominal frequency of the wanted signal, and the level shall be set equal to the reference sensitivity input level minus the interfering level C/I described in Table 2.2.

Table 2.2

Minimum Bit Rate	Reference Sensitivity Input Level	Interfering Level: W/U
2 Mbit/s	-108 dBW	21 dB
2 x 2 Mbit/s	-105 dBW	21 dB
8 Mbit/s	-102 dBW	21 dB
2 x 8 Mbit/s	-102 dBW	21 dB
34 Mbit/s	-99 dBW	21 dB
140/155 Mbit/s	-93 dBW	21 dB

d) The BER of the wanted signal shall be measured.

3.3.2.2 Adjacent channel interference

(a) A bit error monitor capable of detecting errors in the sequence described in 1.2 at the bit rates of Table 2.2 shall be connected to the receiver output.

(b) A standard test signal (Section 1.2) shall be applied to the input port of the receiver via one path of a combining unit. The level of the signal at the receiver input port shall be the reference sensitivity input level given in Table 2.2. The frequency of the standard test signal shall be that of the wanted receive frequency.

(c) An interfering test signal having the same characteristics as described in Section 1.2 shall be applied via the second path of the combining unit. The level and frequency separation of the interfering signal shall be as described in Table 2.3. Frequency separations specified in Table 2.3 are the receiver co-polar channel spacings.

d) The BER of the wanted signal shall be measured with the frequency of the interfering signal set below and then above the wanted carrier.

TABLE 2.3

Minimum Bit Rate	Separation of Wanted and Interfering Signal		Interference Level: W/U (dB)	
	Co-polar	Cross-polar	Co-polar	Cross polar
2 Mbit/s	3.5 MHz	N/A	-6 dB	N/A
2 X 2 Mbit/s	3.5 MHz	N/A	-3 dB	N/A
8 Mbit/s	7 MHz	N/A	-3 dB	N/A
2 x 8 Mbit/s	14 MHz	N/A	-3 dB	N/A
34 Mbit/s	28 MHz	N/A	-3 dB	N/A
140/155 Mbit/s	112 MHz	N/A	-3 dB	N/A

3.3.3 Limits

3.3.3.1 Co-channel interference

The BER measured in sub-clause 3.3.2.1(d) shall not be greater then 10^{-6}.

3.3.3.2 Adjacent channel interference

The BER measured in sub-clause 3.3.2.2(d) shall not be greater than 10^{-5}.

3.4 Spurious Response Rejection

3.4.1 Definition

The spurious response rejection ratio of the receiver is a measure of its ability to discriminate between the wanted signal at the nominal frequency of the receiver and an unwanted signal at any other frequency at which a response is obtained.

3.4.2 Method of Measurement

(a) Referring to the test arrangement in Section 1.3 for measurement of the receiver co-channel interference sensitivity, the interfering signal source shall be replaced with an unmodulated source or sources capable of continuously tuning from 70 MHz to 60 GHz.

(b) The level of the unmodulated source shall be set to zero and the wanted signal set to the reference sensitivity input level given in Table 2.2.

(c) The level of the unmodulated source measured at the receiver input shall be 30 dB greater than that of the wanted signal.

(d) The frequency of the unmodulated interfering signal shall be varied over the range 70 MHz to 60 GHz, excluding frequencies either side of the wanted frequency by twice the relevant co-polar receiver channel spacing given in Table 2.3.

3.4.3 Limits

The BER shall not be worse than 10^{-5} at any point during the test.

3.5 Receiver Spurious Emissions

3.5.1 Definition

Spurious emissions from the receiver are any individual emissions present at its input port which is considered to be at the input of the receiver or diplexer if fitted.

3.5.2 Method of Measurement

(a) The transmitter output port shall be connected to either a spectrum analyzer via an attenuator, or an artificial load with some means of monitoring the emission with a spectrum analyzer or selective voltmeter.

(b) The power level of each emission in the frequency range 70 MHz to 60 GHz, excluding frequencies within the Necessary Bandwidth about the carrier frequency, shall be measured.

3.5.3 Limits

The power of any spurious emission from the receiver measured in Clause 3.5.2(b) including the local oscillator frequency generated by the receiver shall not exceed:

70 MHz to 21.2 GHz	:	-90 dBW
21.2 GHz to 60 GHz	:	-60 dBW

MPT1420

Part 2A

PERFORMANCE SPECIFICATION

Performance Specification for Private Fixed Link Equipment for the transmission of television or radar remoting signals or equivalent for use in the analogue sub-bands of the bands 27.5 - 29.5 GHz

CONTENTS

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1 GENERAL CONDITIONS

1.1 Transmit/receive capacity

The following video baseband bandwidths may be used:

a) Up to 3.5 MHz
b) Up to 6 MHz
c) Up to 10 MHz
d) Up to 14 MHz

These may have subcarriers associated with them.

It is recognised that subcarriers will be used to carry four distinct traffic types:

- CW (eg continuity pilot)
- Low frequency analogue (eg audio)
- Wideband analogue (eg secondary video)
- Data (eg 2 Mbit/sec G703)

1.2 Arrangements for test signals applied to the receiver input

Sources of test signals for application to the receiver input shall be connected in such a way that the return loss presented to the receiver input is not less than 26 dB.

This requirement shall be met irrespective of whether one or more signals are applied to the receiver simultaneously.

The levels of the test signals shall be expressed in terms of the power in dBW incident at the receiver input port.

The effect of any intermodulation products of noise produced in the test equipment shall have a negligible effect.

1.3 Frequency deviation

See Table 2.1.

1.3.1 Primary video

The Primary Video may be defined as that traffic not carried on a sub carrier. The frequency deviation of the primary traffic shall be limited to a level that will ensure that the spectral power densities shown in figures 2.4A and 2.4B are not exceeded when modulated with the relevant standard test signals in paragraphs 1.5.5 and 1.5.6. Note that the mask also contains the maximum allowable centre frequency tolerance and must be taken into consideration when setting the deviation.

1.3.2 Subcarrier deviation of the main carrier

The maximum deviation of the main carrier by the subcarrier for each type of traffic is given in Table 2.1 and these limits should apply both when the subcarrier is modulated or unmodulated.

1.4 Standard test signals

The standard test signal shall be a radio frequency carrier modulated by an assembly of signals comprising a video baseband signal together with sub-carriers.

1.4.1 Signal levels

The level of the test signals applied to the transmitter input ports shall correspond to the maximum level experienced under normal operation. Video signal levels shall be the peak to peak voltage of the composite luminance signal at the transmitter input port expressed in volts. Digital signal levels shall be the peak to peak voltage of the digital signal at the transmitter input port expressed in volts. Audio signal levels shall be the peak to peak power of the audio signal at the transmitter input port expressed in volts.

The manufacturer shall declare the maximum normal signal levels, impedance and return loss at each transmitter input port and each receiver output port. The manufacturer shall also declare the format of any digital interface.

1.5 Baseband parameters

1.5.1 Video interfaces

Level:	Nominally 1V peak-to-peak
Impedance:	75 unbalanced
Minimum return loss:	26dB

1.5.2 Audio interface (if applicable)

Level: 0 to 6dBu (peak level +9 to +15dBm)

Impedance:	Input	600 Ω symmetric or High Impedance (> 10 kΩ)
	Output	600 Ω symmetric or Low Impedance (< 50 Ω)
	Minimum return loss	20dB with respect to nominal impedance at all frequencies over the working frequency range.

1.5.3 Digital interface (if applicable)

For CCITT bit rates the interface should conform to the relevant CCITT Recommendation (e.g. G703 for 2 Mbit/s).

1.5.4 IF interface (if applicable)

Characteristics in accordance with CCIR Recommendation 403-3.

1.5.5 Video baseband test signals

Standard video baseband signals are as follows:

(a) Low Definition Surveillance Television.
100% colour bars

(b) Broadcast Colour Television.
100% colour bars.

(c) Wideband Radar-Remoting.
Pulse stream with the following characteristics:

i)	Pulse width:	40 to 60 nanoseconds
ii)	Pulse Rise/Fall time:	> 15 nanoseconds
iii)	Pulse Amplitude:	To meet manufacturers Declared Peak to Peak Deviation
iv)	Pulse Repetition frequency:	5 MHz

(d) Other modulating signals may be used with the agreement of the Type Approval Authority.

1.5.6 Sub-carrier test signals

The transmitter characteristics of the sub-carrier signals are shown in Table 2.1.

The manufacturer shall make a declaration of the following information on the nature of the modulation and frequency of each sub-carrier:-

i) Sub carrier Frequency (MHz)
ii) Peak to Peak Deviation of the Main Carrier by Unmodulated Sub-carrier (MHz or dBc)
iii) Type of Modulation of Sub-carrier (eg CW, AM, FM, FSK, QPSK, etc)
iv) Bandwidth of Analogue Modulated Signals or Bit rate of Digital Modulated Signals

The standard test signals to be applied to the sub-carriers will be as follows:

(a) Narrowband (Audio) Analogue 6 kHz
(b) Wideband (Video) Analogue 20 kHz
(c) Digital: Pseudo Random Bit Sequence:-

Repetition Rate $2^{15} - 1$ Bits
Polynomial $D^{15} + D^{14} + 1 + 0$

(d) Other sequences may be used with the agreement of the Type Approval Authority.

Video Baseband	<3.5 MHz	<6 MHz	<10 MHz	<14 MHz
Channel Spacing:				
Co-polar	28 MHz	56 MHz	56 MHz	56 MHz
Cross Polar	14 MHz	28 MHz	28 MHz	28 MHz
Maximum Frequency Deviation (pk - pk) of the Main Carrier				
Primary Video	Refer to paragraph 1.3.1 for limit.			
Subcarriers				
- CW (Pilot)	0.6 MHz	1 MHz	1 MHz	N/A
- Narrow Band Analogue (Audio)	0.6 MHz	2 MHz	2 MHz	N/A
- Wideband Analogue (Video)	N/A	4 MHz	4 MHz	N/A
- Digital	N/A	2 MHz	2 MHz	N/A
Spectrum Mask	Fig 2.4A	Fig 2.4B	Fig 2.4B	Fig 2.4B

Table 2.1 : Maximum Frequency Deviations of the Main Carrier.

The number of sub-carriers will be agreed with the type approval authority, but will not normally exceed a maximum of four.

2 TRANSMITTER

2.1 Frequency error

2.1.1 Definition

The frequency error of the transmitter is the difference between the measured carrier frequency and its nominal value.

2.1.2 Method of measurement

(a) The transmitter shall be operated in accordance with the manufacturer's instructions and its output shall be connected to an artificial load (Part 1, Clause 2.7) .

(b) The emission shall be monitored by a frequency counter and the carrier frequency shall be measured in the absence of modulation.

(c) The measurement shall be made under normal test conditions (Part 1, Clause 2.3) and repeated under extreme test conditions (Part 1, Clauses 2.4.1 and 2.4.2 applied simultaneously).

2.1.3 Limits

The frequency error, under both normal and extreme test conditions shall not exceed:

± 100 ppm for : 7.5 GHz, 13 GHz, 14 GHz, 23 GHz (all video systems)
: 38 GHz with basebands up to 3.5 MHz.

± 150 ppm for : 38 GHz with basebands > 3.5 MHz
: 55 GHz (all video systems).

2.2 Carrier power

2.2.1 Definition

The carrier power of a transmitter is the average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle taken under conditions of no modulation.

2.2.2 Method of measurement

(a) The transmitter output port (point C' on the Block Diagram) shall be connected to an artificial load (Part 1, Clause 2.7) with means of measuring the power delivered to this load.

(b) In the absence of modulation, the transmitter shall be operated in accordance with the manufacturer's instructions. The carrier power shall be set to the manufacturer's maximum rated output.

(c) The measurement shall be made under normal test conditions (Part 1, Clause 2.3) and repeated under extreme test conditions (Part 1, Clauses 2.4.1 and 2.4.2 applied simultaneously).

2.2.3 Limits

The carrier output power under extreme test conditions shall be within ± 2 dB of manufacturers maximum rated output power, and shall not exceed ITU Radio Regulations Article 27 limits, where applicable.

2.3 Spurious emissions

2.3.1 Definition

Spurious emissions are emissions on a frequency or frequencies which are outside the necessary bandwidth of the required transmission side bands and the level of which may be reduced without affecting the corresponding transmission of information.

Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude emissions on frequencies immediately outside the necessary bandwidth which result from the modulation process.

2.3.2 Method of measurement

(a) The transmitter output port (point C' on the Block Diagram) shall be connected to either a spectrum analyzer via an attenuator, or an artificial load with some means of monitoring the emission with a spectrum analyzer or selective voltmeter.

(b) The transmitter carrier shall be unmodulated, and at each spurious emission over the frequency range given in Table 2.2 the level of the emission shall be measured relative to the level of the carrier emission.

(c) The power level of each emission shall be determined by applying the ratio measured in Clause 2.3.2(b) to the carrier power determined in Section 2.2.

Band	Frequency Range (GHz)	
	Lower Limit	Upper Limit
28 GHz	1	55

Table 2.2 Frequency Ranges for Spurious Emission Tests

2.3.3 Limits

The power of any spurious emission shall not exceed -79 dBW within the frequency group of the transmitter, but excluding the necessary bandwidth as defined in Clause 2.3.1. Spurious emissions outside the frequency group of the transmitter shall not exceed the following values:

Up to 20 GHz : -90 dBW
20 GHz to 60 GHz : -60 dBW

2.4 Radiated spectrum

2.4.1 Method of measurement

(a) The transmitter output port (point C' on the Block Diagram) shall be connected to either a spectrum analyzer via an attenuator, or an artificial load with some means of monitoring the emissions with a spectrum analyzer. The spectrum analyzer shall have a variable persistence display or digital storage display and its controls shall be adjusted as in Table 2.3.

	Baseband < 3.5 MHz	Baseband < 14 MHz
RF Centre Frequency	Transmitter carrier frequency	
IF Bandwidth	30 kHz	
Total Sweep Width	50 MHz	100 MHz
Amplitude Scale	Logarithmic 10 dB/div	
Video Filter	300 Hz	
Total scan time	20 sec.	40 sec.

Table 2.3 Spectrum Analyzer Settings

(b) The unmodulated transmitter carrier shall be observed and it's amplitude on the display screen set to a convenient datum level by the adjustment of the spectrum analyzer attenuator controls.

(c) The transmitter shall be modulated by a composite signal having the characteristics indicated in Clauses 1.5.5 and 1.5.6 and the spectrum analyzer display shall be recorded.

NOTE: In cases where the modulation cannot be removed from the digitally modulated sub-carrier the IF bandwidth may have to be adjusted to a higher value sufficient to display the correct amplitude.

2.4.2 Limits

The transmitter radiated spectrum under the specified conditions of modulation shall be such that no component shall have a level greater than that indicated in Figures 2.4A or 2.4B. These Figures include an allowance for frequency tolerance.

Variations of up to + 2 dBc in the observed modulated carrier level shall be allowed.

3 RECEIVER

3.1 Receiver characteristics

All levels to point C on block diagram.

3.1.1 Input level range

From -50dBW to receive threshold as defined in 3.2.1.

3.1.2 Spurious emissions

The frequency range in which the spurious emissions specifications apply is 1 GHz to 60 GHz, as specified in Table 2.2. The limit values are:

Up to 20 GHz : -90 dBW
20 GHz to 60 GHz : -60 dBW

NOTE: Refer to paragraph 2.3.1 for definition of spurious emissions.

3.2 Receiver performance

3.2.1 Receiver threshold

The Receiver Threshold is defined as the receive signal level (referred to point C of the RF Block Diagram - Part 1, Fig 1.2) at which a certain minimum performance is reached. In view of the wide variety of equipment types to be found in practice it is not proposed to state limits for this parameter. However, in order to specify meaningful interference limits, it is necessary to use the measured receiver threshold as a baseline.

The Receiver Threshold is defined in terms of the FM threshold of the equipment. The signal/unweighted noise ratio shall be measured at each output port (video, audio etc) as a function of receive signal level. The Receiver Threshold shall be defined as the receiver level at which the relationship between the receive signal level and the output signal/noise ratio deviates by 3dB. The limits are given in Table 2.4.

Type of Service	Threshold Sensitivity
TV, Baseband < 3.5 MHz	-98 dBW
TV, Baseband < 14 MHz	-85 dBW
Wide-Band Radar Remoting (Baseband < 14 MHz)	-84 dBW

Table 2.4 Receiver Threshold Sensitivity

3.2.2 Interference sensitivity

3.2.2.1 Co-channel interference

For planning purposes it should be assumed that the level of co-channel interference into the wideband analogue channel should not exceed the limits in Table 2.5.

Type of Service	Interference Limits (dBW)
TV, baseband < 3.5 MHz	-126
TV, baseband < 10 MHz	-123
TV and wideband radar remoting, baseband < 14 MHz	-122

Table 2.5 Co-channel Interference Limits

3.2.2.2 Adjacent channel interference

For a receiver operating with a 'WANTED' signal whose level is 9dB above the receiver threshold as defined in 3.2.1 above, the introduction at point C of a like modulated interferer at the level and frequency separation given in Table 2.6 should not result in a degradation of the output signal/noise ratio of more than 1dB.